Answers to Odd-Numbered Problems

CHAPTER 1

1.1. (a) 2 m; (b) 0.8 m northward and 0.4 m eastward; (c) 0.8944 m

1.5. 21

1.7. $2\mathbf{a}_x + 2\mathbf{a}_y + \mathbf{a}_z$

1.9. $(4\mathbf{a}_x - 5\mathbf{a}_y + 3\mathbf{a}_z)/5\sqrt{2}$; $6\sqrt{2}$

1.11. $(4\mathbf{a}_x + 4\mathbf{a}_y + \mathbf{a}_z)\,dz$

1.13. $(4\mathbf{a}_x - \mathbf{a}_y)/\sqrt{17}$

1.15. $x + y + z =$ constant

1.17. $\omega(-y\mathbf{a}_x + x\mathbf{a}_y)$

1.19. Traveling wave progressing in the negative z-direction

1.21. (a) Linear; (b) circular; (c) elliptical

1.23. Elliptical polarization

1.25. $5\cos(\omega t + 6.87°)$

1.27. $\sqrt{8\pi\epsilon_0 l^2 mg}$

1.29. $\dfrac{0.0555Q}{\epsilon_0}(\mathbf{a}_x + \mathbf{a}_y + \mathbf{a}_z)$ N/C

1.31. $\dfrac{10^{-7}}{\pi\epsilon_0}\sum_{i=1}^{50}(2i - 1)[10^{-4}(2i - 1)^2 + 1]^{-3/2}\mathbf{a}_y$

1.33. $\dfrac{4 \times 10^{-7}}{\pi\epsilon_0}\sum_{i=1}^{50}\sum_{j=1}^{50}[10^{-4}(2i - 1)^2 + 10^{-4}(2j - 1)^2 + 1]^{-3/2}\mathbf{a}_z$

1.35. (a) $0.4485 \times 10^{-6}\sin 2\pi \times 10^7 t\,\mathbf{a}_x$ A/m^2
(b) $0.4485 \times 10^{-8}\sin 2\pi \times 10^7 t$ A

1.37. $d\mathbf{F}_1 = 0$; $d\mathbf{F}_2 = \dfrac{\mu_0}{4\pi}I_1 I_2\,dx\,dy\,\mathbf{a}_x$

1.39. (a) $(5 \times 10^{-5}\mu_0/\pi)\mathbf{a}_z$; (b) $-(10^{-4}\mu_0/4\pi)\mathbf{a}_z$

1.41. $0.179\mu_0 I\mathbf{a}_z$

1.43. $-v_0 B_0(14\mathbf{a}_y + 7\mathbf{a}_z)$

CHAPTER 2

2.1. 0.855
2.3. 1
2.7. 1/6
2.9. $\dfrac{(4n^2 - 1)(1 - e^{-1})}{12n^3(1 - e^{-1/n})} e^{-1/2n}$; 0.20825, 0.21009, 0.21070, 0.21071
2.11. 16π
2.13. 30 A
2.15. $-B_0 b v_0 \left(\dfrac{1}{x_0 + a} - \dfrac{1}{x_0} \right)$
2.17. $B_0 b \omega \ln \dfrac{x_0 + a}{x_0} \sin \omega t - B_0 b v_0 \left(\dfrac{1}{x_0 + a} - \dfrac{1}{x_0} \right) \cos \omega t$
2.19. $2B_0\, \omega \sin \omega t$
2.21. 0
2.23. (a) 0; (b) $I_1 - I_2$
2.25. $\dfrac{J_0 r}{2}$ for $r < a$ and $\dfrac{J_0 a^2}{2r}$ for $r > a$, where r is the radial distance from the axis; direction circular to the axis of the wire
2.27. (a) $I/4$; (b) $I/4$
2.29. 0.31606 C
2.31. $\rho_0 r/3\epsilon_0$ for $r < a$ and $\rho_0 a^3/3\epsilon_0 r^2$ for $r > a$, where r is the radial distance from the center of the charge, and direction radially away from the center of the charge
2.33. -1 A
2.35. $\pi^2/2$

CHAPTER 3

3.1. $\omega B_0 \dfrac{z^2}{2} \sin \omega t\, \mathbf{a}_x$
3.3. (a) $z\mathbf{a}_x + x\mathbf{a}_y + y\mathbf{a}_z$; (b) 0
3.5. $\dfrac{1}{3} \times 10^{-7} \cos (6\pi \times 10^8 t - 2\pi z)\, \mathbf{a}_y$ Wb/m^2
3.7. $\mathbf{B} = -\omega \mu_0 \epsilon_0 E_0 \dfrac{z^3}{3} \cos \omega t\, \mathbf{a}_y$

$\mathbf{E} = -\omega^2 \mu_0 \epsilon_0 E_0 \dfrac{z^4}{12} \sin \omega t\, \mathbf{a}_x$
3.9. $\mathbf{E} = 10 \cos (6\pi \times 10^8 t - 2\pi z)\, \mathbf{a}_x$

$\mathbf{B} = \dfrac{10^{-7}}{3} \cos (6\pi \times 10^8 t - 2\pi z)\, \mathbf{a}_y$
3.11. $J_0(a + z)\mathbf{a}_y$ for $-a < z < 0$, $J_0(a - z)\mathbf{a}_y$ for $0 < z < a$, 0 otherwise
3.13. Curl will have a component in the y-direction in addition to the x-component
3.15. Curl has only a z-component

3.17. $\oint_C \mathrm{A} \cdot d\mathbf{l} = 0$ for any C

3.19. (a) $3(x^2 + y^2 + z^2)$; (b) 0

3.21. (a) $-x\mathbf{a}_z, y$; (b) $-\mathbf{a}_z, 0$; (c) 0, 1; (d) 0, 0

3.23. $\dfrac{\rho_0}{2a\epsilon_0}(x^2 - a^2)\,\mathbf{a}_x$ for $-a < x < a$, 0 otherwise

3.25. (a) and (c)

3.27. $\nabla \cdot \mathbf{r} = 3$

3.29. $\oint_S \mathbf{A} \cdot d\mathbf{S} = 2\pi, \nabla \cdot \mathbf{A} = 3$

3.31. 0

CHAPTER 4

4.1. (a) 0.2 A; (b) 0; (c) 0.2 A

4.3. (a) $0.2 \cos \omega t$ A; (b) $0.2 \sin \omega t$ A; (c) $0.2828 \sin(\omega t + 45°)$ A

4.5. (a) $\pm 0.0368 \cos \omega t\, \mathbf{a}_y$ for $z = 0\pm$; (b) $\pm 0.0135 \cos \omega t\, \mathbf{a}_y$ for $z = 0\pm$

4.7. $J_0 \dfrac{a}{2}\,\mathbf{a}_y$ for $z < -a$, $-J_0\left(z + \dfrac{z^2}{2a}\right)\mathbf{a}_y$ for $-a < z < 0$, $-J_0\left(z - \dfrac{z^2}{2a}\right)\mathbf{a}_y$ for $0 < z < a$, $-J_0 \dfrac{a}{2}\,\mathbf{a}_y$ for $z > a$

4.9. $-(\rho_0 a/\epsilon_0)\mathbf{a}_x$ for $x < -a$, $(\rho_0 x/\epsilon_0)\mathbf{a}_x$ for $-a < x < a$, $(\rho_0 a/\epsilon_0)\mathbf{a}_x$ for $x > a$

4.15. $(t - z\sqrt{\mu_0\epsilon_0})^2$ corresponds to a (+) wave; $(t + z\sqrt{\mu_0\epsilon_0})^2$ corresponds to a (−) wave

4.17. $C = \dfrac{\eta_0 J_{S0}}{2}$

For Problem 4.13, $E_x = \dfrac{\eta_0 J_{S0}}{2}(t \mp z\sqrt{\mu_0\epsilon_0})^2$ for $z \gtrless 0$ and

$H_y = \pm\dfrac{E_x}{\eta_0}$ for $z \gtrless 0$

4.19. $\mathbf{E} = [0.1\eta_0 \cos(6\pi \times 10^8 t \mp 2\pi z) + 0.05\eta_0 \cos(12\pi \times 10^8 t \mp 4\pi z)]\mathbf{a}_x$ for $z \gtrless 0$

$\mathbf{H} = \pm\dfrac{E_x}{\eta_0}\,\mathbf{a}_y$ for $z \gtrless 0$

4.21. Spacing $= \lambda/4$; amplitudes $= J_{S0}, \dfrac{1}{3} J_{S0}$; phase difference $= \pi/2$

4.23. (a) right circular; (b) left circular

4.25.
$$\frac{E_0}{2}[\cos(\omega t + \beta z)\,\mathbf{a}_x - \sin(\omega t + \beta z)\,\mathbf{a}_y] + \frac{E_0}{2}[\cos(\omega t + \beta z)\,\mathbf{a}_x + \sin(\omega t + \beta z)\,\mathbf{a}_y]$$

4.27.
$$1.25\,E_0\left[\cos\left(2\pi \times 10^8 t - \frac{2\pi}{3}z + 0.2048\pi\right)\mathbf{a}_x + \sin\left(2\pi \times 10^8 t - \frac{2\pi}{3}z + 0.2048\pi\right)\mathbf{a}_y\right]$$

4.29. (a) Same as in Figure 4.17, except displaced to the left by 1/3 μs;

(b) 75.4 V/m for $300(n - 1/3) < |z| < 300n$ and -37.7 V/m for $300(n - 1) < |z| < 300(n - 1/3), n = 1, 2, 3, \ldots;$

(c) $0.2z/|z|$ A/m for $300(n - 1) < |z| < 300(n - 2/3)$ and $-0.1z/|z|$ A/m for $300(n - 2/3) < |z| < 300n, n = 1, 2, 3, \ldots$

4.31. 30 mV/m

CHAPTER 5

5.1. (a) 0.1724×10^{-4} V/m, 0.1724×10^{-6} V, 0.1724×10^{-5} Ω;
(b) 0.2857×10^{-4} V/m, 0.2857×10^{-6} V, 0.2857×10^{-5} Ω;
(c) 250 V/m, 2.5 V, 25 Ω

5.3. 1.5245×10^{-19} s

5.5. (a) $-8.667 \times 10^{-7} \sin 2\pi \times 10^9 t$ A; (b) $-2.778 \times 10^{-6} \sin 2\pi \times 10^9 t$ A;
(c) $-4.444 \times 10^{-5} \sin 2\pi \times 10^9 t$ A

5.7. (a) $\epsilon_0 E_0(4\mathbf{a}_x + 2\mathbf{a}_y + 2\mathbf{a}_z)$; (b) $8\epsilon_0 E_0(\mathbf{a}_x + \mathbf{a}_y + \mathbf{a}_z)$;
(c) $0.5E_0(3\mathbf{a}_x - \mathbf{a}_y - \mathbf{a}_z)$

5.9. $|e|^2 B_0 a^2/2m$, 0.7035×10^{-18} A-m^2

5.11. $0.5 \times 10^{-6} \sin 2\pi z$ A

5.13. $\dfrac{\partial^2 \bar{H}_y}{\partial z^2} = \bar{\gamma}^2 \bar{H}_y$

5.15. 0.00083 Np/m, 4.7562×10^{-3} rad/m, 1.32105×10^8 m/s, 1321.05 m, $(161.102 + j28.115)$ Ω

5.17. $\mathbf{E} = 3.736e^{\mp 0.0404z} \cos\left(2\pi \times 10^6 t \mp 0.0976z + \dfrac{\pi}{8}\right)\mathbf{a}_x$ for $z \gtrless 0$

$\mathbf{H} = \pm 0.05e^{\mp 0.0404z} \cos(2\pi \times 10^6 t \mp 0.0976z)\,\mathbf{a}_y$ for $z \gtrless 0$

5.19. 16.09 m, 1.917:1, 90° out of phase

5.21. (a) 30 MHz; (b) 5 m; (c) 1.5×10^8 m/s; (d) $4\epsilon_0$;
(e) $\dfrac{1}{6\pi} \cos(6\pi \times 10^7 t - 0.4\pi z)\,\mathbf{a}_y$ A/m

5.23. (a) Same as in Figure 4.17;
(b) 75.4 V/m for $100(n - 1/3) < |z| < 100n$ and -37.7 V/m for $100(n - 1) < |z| < 100(n - 1/3), n = 1, 2, 3, \ldots;$
(c) $0.6z/|z|$ A/m for $100(n - 1) < |z| < 100(n - 2/3)$ and $-0.3z/|z|$ A/m for $100(n - 2/3) < |z| < 100n$, for $n = 1, 2, 3, \ldots$

5.25. (a) 0.0211 Np/m, 18.73 rad/m, 0.3354×10^8 m/s, 0.3354 m, 42.15 Ω;
(b) $2\pi \times 10^{-3}$ Np/m, $2\pi \times 10^{-3}$ rad/m, 10^7 m/s, 1000 m, $2\pi(1 + j)$ Ω

5.27. $E_0(4\mathbf{a}_x + 2\mathbf{a}_y - 6\mathbf{a}_z)$, $H_0(4\mathbf{a}_x - 3\mathbf{a}_y)$

5.29. $2\epsilon_0$

5.31. Yes

5.33. $4|D_0|$

5.35. (b) $\frac{E_0}{120\pi}\cos 10\pi x \sin 3\pi \times 10^9 t\ \mathbf{a}_y$;

(c) $\frac{E_0}{120\pi}\sin 3\pi \times 10^9 t\ \mathbf{a}_z$ on both sheets

5.37. (a) 4; (b) 16; (c) 4/9

5.39. $\mathbf{E}_r = -E_0\cos(\omega t + \beta z)\,\mathbf{a}_x, \mathbf{H}_r = \frac{E_0}{\eta}\cos(\omega t + \beta z)\,\mathbf{a}_y$

$\mathbf{E} = 2E_0 \sin \omega t \sin \beta z\ \mathbf{a}_x, \mathbf{H} = \frac{2E_0}{\eta}\cos \omega t \cos \beta z\ \mathbf{a}_y$

$[\mathbf{J}_S]_{z=0} = \frac{2E_0}{\eta}\cos \omega t\ \mathbf{a}_x$

CHAPTER 6

6.1. (a) $\frac{x\mathbf{a}_x + y\mathbf{a}_y + z\mathbf{a}_z}{\sqrt{x^2 + y^2 + z^2}}$; (b) $yz\mathbf{a}_x + zx\mathbf{a}_y + xy\mathbf{a}_z$

6.3. $\frac{1}{3\sqrt{5}}(5\mathbf{a}_x + 2\mathbf{a}_y + 4\mathbf{a}_z)$

6.5. 2.121

6.7. $Q/30\pi\epsilon_0$

6.9. $V = \frac{10^{-5}}{\pi\epsilon_0}\sum_{i=1}^{50}[10^{-4}(2i - 1)^2 + y^2]^{-1/2}$

$\mathbf{E} = \frac{10^{-5}}{\pi\epsilon_0}\sum_{i=1}^{50}[10^{-4}(2i - 1)^2 + 1]^{-3/2}\mathbf{a}_y$

6.11. (a) $-\frac{4\epsilon_0 V_0}{9d^2}\left(\frac{x}{d}\right)^{-2/3}$; (b) $[\rho_s]_{x=0} = 0, [\rho_s]_{x=d} = \frac{4\epsilon_0 V_0}{3d}$

6.13. $V = -\frac{kx^3}{6\epsilon} + \frac{kd^2x}{8\epsilon}$ for $-\frac{d}{2} < x < \frac{d}{2}$

6.15. (a) $\frac{\epsilon_1(d - t) + \epsilon_2(t - x)}{\epsilon_1(d - t) + \epsilon_2 t}V_0$ for $0 < x < t$,

$\frac{\epsilon_1(d - x)}{\epsilon_1(d - t) + \epsilon_2 t}V_0$ for $t < x < d$

(b) $\frac{\epsilon_1(d - t)}{\epsilon_1(d - t) + \epsilon_2 t}V_0$; (c) $\frac{\epsilon_1\epsilon_2 wl}{\epsilon_1(d - t) + \epsilon_2 t}$

6.17. $\frac{\mu_1\mu_2}{\mu_1 + \mu_2}\left(\frac{2dl}{w}\right)$

6.19. $\overline{Y}_{in} = j\omega\frac{\epsilon wl}{d}\left(1 + \frac{\omega^2\mu\epsilon l^2}{3}\right)$; equivalent circuit is a series combination of

$C = \frac{\epsilon wl}{d}$ and $\frac{1}{3}L$, where $L = \frac{\mu dl}{w}$

6.21. (b) $\bar{Z}_{in} = \dfrac{j\omega\mu dl}{w}\left(1 - \dfrac{j\omega\mu\sigma l^2}{3}\right)$; equivalent circuit consists of an inductor L in parallel with a resistor $3R$ where $L = \mu dl/w$ and $R = d/\sigma lw$

6.23. (a) $2\pi \cos(2\pi \times 10^6 t - 0.02\pi z)$ V; (b) $0.25 \cos(2\pi \times 10^6 t - 0.02\pi z)$ A; (c) $0.5\pi \cos^2(2\pi \times 10^6 t - 0.02\pi z)$ W

6.29. $\mathscr{L} = 0.429\mu$, $\mathscr{C} = 2.333\epsilon$, $\mathscr{G} = 2.333\sigma$; exact values are 0.4192μ, 2.3855ϵ, and 2.3855σ, respectively

6.31. $\dfrac{1}{9}\mu$, 9ϵ, 9σ

CHAPTER 7

7.1. (a) $\mathscr{L} = 0.278 \times 10^{-6}$ H/m, $\mathscr{G} = 4.524 \times 10^{-16}$ S/m; (b) $(52.73 + j0)\ \Omega$

7.3. $\bar{V}(z) = 2\bar{A} \cos \beta z$, $\bar{I}(z) = -j\dfrac{2\bar{A}}{Z_0} \sin \beta z$; $\bar{Z}_{in} = -jZ_0 \cot \beta l$

7.5. (a) 0.60286 m; (b) 1.35286 m

7.7. (a) 50 Ω; (b) 8.09 V, 0.1176 A

7.9. (a) 10^8 m/s; (b) 10^6 m, 2×10^{-6}, $j0.00079\ \Omega$; 1m, 2, 0; 8m, 0.25, ∞

7.11. (a) $\dfrac{1}{16}P_i$; (b) $\dfrac{9}{16}P_i$; (c) $\dfrac{3}{8}P_i$

7.13. 150 Ω

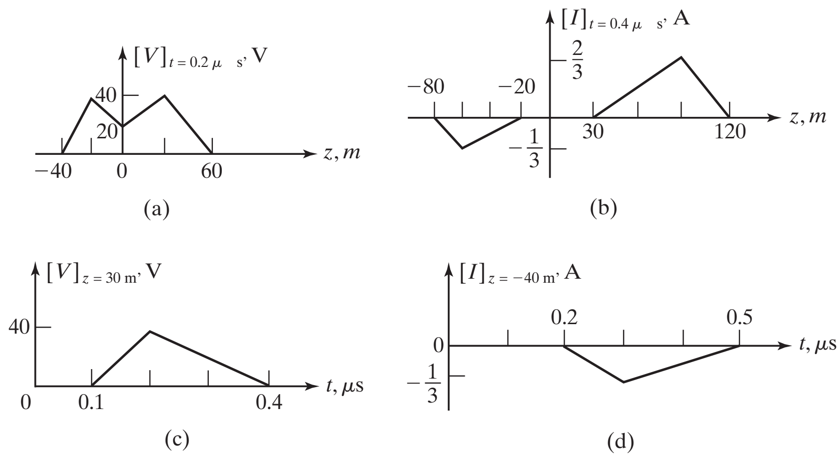
7.17. −0.00533 S, 1.667

7.19. 0.14λ, 0.192λ

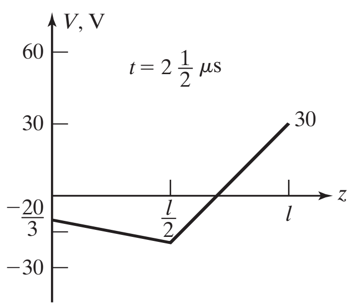
7.21. (a) 40 V for $-40 < z < 60$ m, 0 otherwise; (b) $\dfrac{2}{3}$ A for $0 < z < 120$ m, $-\dfrac{1}{3}$ A for -80 m $< z < 0$, 0 otherwise; (c) 0 for $0 < t < 0.1\ \mu$s, 40 V for $t > 0.1\ \mu$s; (d) 0 for $0 < t < 0.2\ \mu$s, $-\dfrac{1}{3}$ A for $t > 0.2\ \mu$s

7.23. (a) 60 V, 1 A; (b) 67.5 V, 0.9 A; (c) −7.5 V, 0.1 A

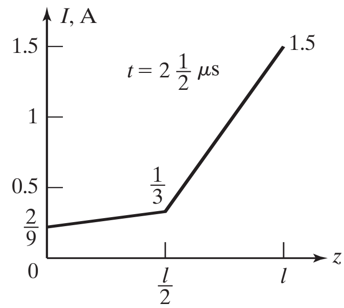
7.25.



7.27.



(a)



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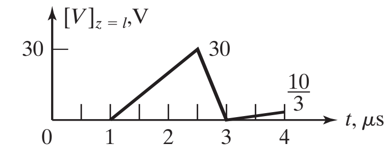


(c)

7.29. 1.46 V

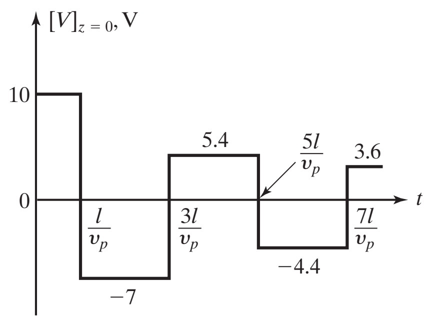
7.31. (a) 40 V for $-l < z < l$; $-\dfrac{2}{3}$ A for $-l < z < 0$, $\dfrac{1}{3}$ A for $0 < z < l$;

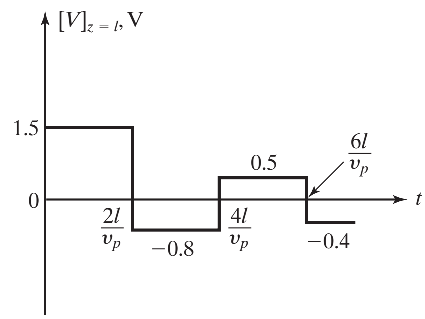
(b) $\dfrac{130}{3} \times 10^{-6}$ J;

(c) Voltage across 60 Ω = 40 V for $0 < t < 1$ μs, 10 V for $1 < t < 3$ μs, 0 otherwise; voltage across 120 Ω = 40 V for $0 < t < 1$ μs, 0 otherwise;

(d) $\dfrac{130}{3} \times 10^{-6}$ J

7.33.





7.35. (a) 38.4 Ω; (b) 48.4 Ω

CHAPTER 8

8.1. $0.05\pi(\sqrt{3}\mathbf{a}_x + \mathbf{a}_y)$

8.3. $\dfrac{1}{2\sqrt{2}}\mathbf{a}_x + \dfrac{\sqrt{3}}{2}\mathbf{a}_y + \dfrac{1}{2\sqrt{2}}\mathbf{a}_z$

8.5. (a) Yes; (b) $\dfrac{1}{24\pi}(\sqrt{3}\mathbf{a}_y - \mathbf{a}_z)\cos[6\pi \times 10^7 t - 0.1\pi(y + \sqrt{3}z)]$

8.7. (a) $\frac{1}{2}(\mathbf{a}_x + \sqrt{3}\mathbf{a}_z)$; (b) $8\sqrt{3}$ m, 24 m
8.9. 1 cm
8.11. 3600 MHz, 5400 MHz
8.13. $TE_{1,0}$ mode; $10 \sin 20\pi x \sin\left(10^{10}\pi t - \frac{80\pi}{3}z\right)\mathbf{a}_y$
8.15. 0.5769×10^8 m/s
8.17. (a) $2.121\sqrt{k\omega_0}$, $1.414\sqrt{k\omega_0}$; (b) $2\sqrt{k\omega_0}$, $2\sqrt{k\omega_0}$; (c) $2.121\sqrt{k\omega_0}$, $2.828\sqrt{k\omega_0}$
8.19. $TE_{1,0}$, $TE_{0,1}$, $TE_{2,0}$, $TE_{1,1}$, and $TM_{1,1}$
8.21. 6.5 cm, 3.5 cm
8.23. 3535.5 MHz ($TE_{1,0,1}$, $TE_{0,1,1}$), 4330.1 MHz ($TE_{1,1,1}$, $TM_{1,1,1}$), 5590.2 MHz ($TE_{2,0,1}$, $TE_{0,2,1}$, $TE_{1,0,2}$, $TE_{0,1,2}$)
8.25. (a) 41.81°; (b) 48.6°
8.27. $\mathbf{E}_r = -0.1716E_0\mathbf{a}_y \cos[6\pi \times 10^8 t + \sqrt{2}\pi(x - z)]$
$\mathbf{E}_t = 0.8284E_0\mathbf{a}_y \cos[6\pi \times 10^8 t - \sqrt{2}\pi(\sqrt{2}x + z)]$
8.29. 75.52°
8.31. $\sqrt{3}$

CHAPTER 9

9.1. $0.2\pi \cos 2\pi \times 10^7 t$ A
9.5. 0.2λ
9.7. (a) 1.257×10^{-3} V/m; (b) $R_{rad} = 0.0351\ \Omega$, $\langle P_{rad}\rangle = 1.7546$ W
9.9. 1.111 W
9.11. $\sqrt{(D_2R_{rad2})/(D_1R_{rad1})}$
9.13. $1\frac{7}{8}$
9.15. 0.60943
9.17. 1.015 W
9.19. (a) $E_\theta = -\frac{\eta\beta L I_0 \sin\theta}{8\pi r}\sin(\omega t - \beta r)$, $H_\phi = \frac{E_\theta}{\eta}$;
(b) $R_{rad} = 20\pi^2(L/\lambda)^2$, $D = 1.5$
9.21. $-\frac{\pi}{4}$, $\cos\left(\frac{\pi}{4}\cos\psi - \frac{\pi}{8}\right)$
9.23. $\cos^2\left(\frac{\pi}{2}\cos\psi\right)$
9.25. $\left|\cos\psi\cos\left(\frac{\pi}{4}\cos\psi - \frac{\pi}{4}\right)\right|$
9.27. $\left[\cos\left(\frac{\pi}{2}\cos\theta\right)\right]\Big/\sin\theta$, where θ is the angle from the vertical, $D = 3.284$
9.29. 4
9.31. 0.00587 V
9.33. 13.262 A

CHAPTER 10

10.3. (a) 5×10^8 m/s; (b) 50 m; (c) 1000

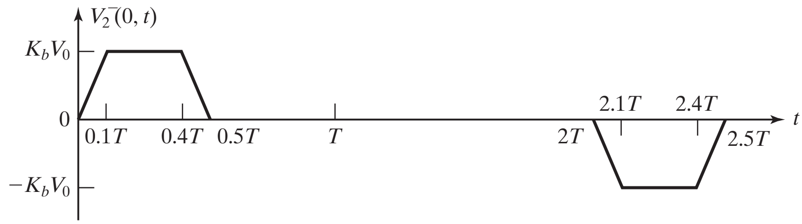
10.5. $101.31°$

10.7. 143.24

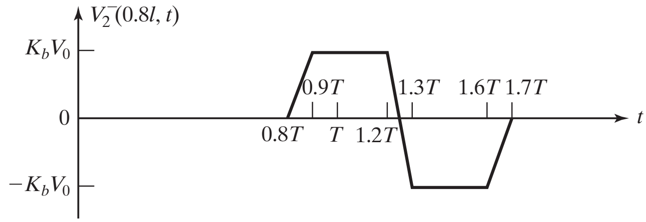
10.9. 121.71 db

10.11. (a) $10lK_fV_0/T$ for $T < t < 1.1T$, $-10lK_fV_0/\mathrm{T}$ for $1.4T < t < 1.5T$, 0 otherwise

(b)



(c)



10.13. (a) $-0.2K_bV_0(z/l)$ for $0.9l < z < l$;
(b) K_bV_0 for $0 < z < 0.9l$, $10K_bV_0(1 - z/l)$ for $0.9l < z < l$;
(c) K_bV_0 for $0 < z < 0.9l$, $K_bV_0(10 - 10.2z/l)$ for $0.9l < z < l$

10.15. $\Gamma = -0.3252$, $\tau = 0.6748$

10.19. (a) 0.1654×10^{-3} V/m; (b) $R_{\text{rad}} = 0.6077 \times 10^{-3}\ \Omega$, $\langle P_{\text{rad}} \rangle = 0.0304$ W

APPENDIX A

A.1. $-3\mathbf{a}_x + \sqrt{3}\mathbf{a}_y + \mathbf{a}_z$

A.3. Equal

A.5. $-\dfrac{1}{\sqrt{2}}, \dfrac{1}{\sqrt{2}}\mathbf{a}_z$

A.7. $13\mathbf{a}_r + 6\mathbf{a}_z$

APPENDIX B

B.1. (a) $-\sin\phi\, \mathbf{a}_z$, $\cos\phi$; (b) 0, 0 except at $r = 0$; (c) 0 except at $r = 0$, 0

B.3. $\dfrac{1}{r}\dfrac{\partial}{\partial r}\left(r\dfrac{\partial \Phi}{\partial r}\right) + \dfrac{1}{r^2}\dfrac{\partial^2 \Phi}{\partial \phi^2} + \dfrac{\partial^2 \Phi}{\partial z^2}$

B.5. (a) $-\dfrac{1}{r^2}(\sin\theta\, \mathbf{a}_r - \cos\theta\, \mathbf{a}_\theta)$; (b) $\cos\theta\, \mathbf{a}_r - \sin\theta\, \mathbf{a}_\theta$